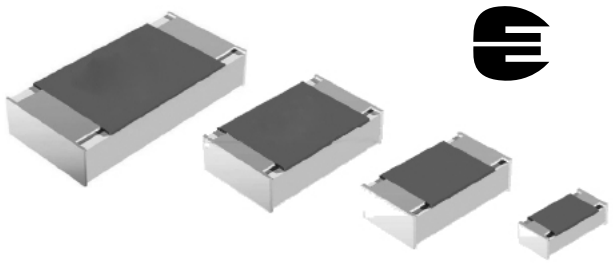
MCS 0402, MCT 0603, MCU 0805, MCA 1206 - Precision

Precision Thin Film Chip Resistors



Thin film flat chip resistors combine the proven reliability of the professional products with an advanced level of precision and stability. Therefore they are perfectly suited for applications in the fields of test and measuring equipment together with industrial and medical electronics.

FEATURES

- Approved to EN 140401-801
- Low TCR: ± 10 ppm/K to ± 25 ppm/K
- Precision tolerance of resistance: ± 0.1 % and ± 0.25 %
- Superior overall stability: Class 0.1 and 0.25
- Lead (Pb)-free solder contacts
- Waste gas resistance verified by ASTM B 809
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

APPLICATIONS

- Automotive
- Test and measuring equipment
- Medical equipment
- Industrial equipment

TECHNICAL SPECIFICATIONS

	MCS 0402		MCT 0603		MCU 0805		MCA 1206	
Imperial size	0402		0603		0805		1206	
Metric size code	RR1005M		RR1608M		RR2012M		RR3216M	
Resistance range	100 Ω to 221 kΩ		39 Ω to 511 kΩ		39 Ω to 1.5 MΩ		39 Ω to 2 MΩ	
Resistance tolerance	± 0.25 %; ± 0.1 %							
Temperature coefficient	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K							
Operation mode	Precision	Standard	Precision	Standard	Precision	Standard	Precision	Standard
Rated dissipation, P_{70} (1)	0.016 W	0.063 W	0.032 W	0.1 W	0.050 W	0.125 W	0.1 W	0.25 W
Operating voltage, $U_{max.}$ AC/DC	12.5 V	50 V	25 V	75 V	35 V	150 V	50 V	200 V
Permissible film temperature, ϑ_F max.	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C	85 °C	125 °C
Operating temperature range	- 10 °C to 85 °C	- 55 °C to 125 °C	- 10 °C to 85 °C	- 55 °C to 125 °C	- 10 °C to 85 °C	- 55 °C to 125 °C	- 10 °C to 85 °C	- 55 °C to 125 °C
Max. resistance change at P_{70} for resistance range, $\lvert\Delta R/R\rvert$ max., after:	100 Ω to 221 kΩ		39 Ω to 511 kΩ		39 Ω to 1.5 MΩ		39 Ω to 2 MΩ	
1000 h	≤ 0.1 %	≤ 0.2 %	≤ 0.1 %	≤ 0.2 %	≤ 0.1 %	≤ 0.2 %	≤ 0.05 %	≤ 0.1 %
8000 h	≤ 0.2 %	≤ 0.4 %	≤ 0.2 %	≤ 0.4 %	≤ 0.2 %	≤ 0.4 %	≤ 0.1 %	≤ 0.25 %
225 000 h	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.5 %	≤ 1.0 %	≤ 0.25 %	≤ 0.5 %
Specified lifetime	225 000 h		225 000 h		225 000 h		225 000 h	
Insulation voltage:								
1 min; U_{ins}	75 V		100 V		200 V		300 V	
Continuous	75 V		75 V		75 V		75 V	
Failure rate: $FIT_{observed}$	≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h		≤ 0.1 x 10^{-9}/h	

Note

(1) The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature is not exceeded.

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: MCT06030D4641BPW00

M	C	T	0	6	0	3	0	D	4	6	4	1	B	P	W	0	0

TYPE/SIZE	VERSION	TCR	RESISTANCE	TOLERANCE	PACKAGING
MCS0402 **MCT0603** **MCU0805** **MCA1206**	**0** = Neutral	**F** = ± 10 ppm/K **E** = ± 15 ppm/K **D** = ± 25 ppm/K	**3 digit value** **1 digit** **multiplier** MULTIPLIER **9** = $*10^{-1}$ **0** = $*10^{0}$ **1** = $*10^{1}$ **2** = $*10^{2}$ **3** = $*10^{3}$ **4** = $*10^{4}$	**B** = ± 0.1 % **C** = ± 0.25 %	**P1** **P5** **PW** **E1** **E0**

Product Description: MCT 0603-25 0.1 % PW 4K64

MCT	0603	-25	0.1 %	PW	4K64
TYPE	SIZE	TCR	TOLERANCE	PACKAGING	RESISTANCE
MCS **MCT** **MCU** **MCA**	**0402** **0603** **0805** **1206**	± **10** ppm/K ± **15** ppm/K ± **25** ppm/K	± **0.1 %** ± **0.25 %**	**P1** **P5** **PW** **E1** **E0**	**4K64** = 4.64 kΩ **50R1** = 50.1 Ω

Note

- Products can be ordered using either the PART NUMBER or PRODUCT DESCRIPTION.

TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

DESCRIPTION		RESISTANCE RANGE			
TCR	**TOLERANCE**	**MCS 0402**	**MCT 0603**	**MCU 0805**	**MCA 1206**
± 25 ppm/K	± 0.25 %	100 Ω to 221 kΩ	39 Ω to 511 kΩ	39 Ω to 1.5 MΩ	39 Ω to 2 MΩ
	± 0.1 %	**100 Ω to 221 kΩ**	**47 Ω to 511 kΩ**	**47 Ω to 1.5 MΩ**	**47 Ω to 2 MΩ**
± 15 ppm/K	± 0.25 %	100 Ω to 150 kΩ	39 Ω to 332 kΩ	39 Ω to 1 MΩ	39 Ω to 1.5 MΩ
	± 0.1 %	**100 Ω to 150 kΩ**	**47 Ω to 332 kΩ**	**47 Ω to 1 MΩ**	**47 Ω to 1.5 MΩ**
± 10 ppm/K	± 0.25 %	100 Ω to 130 kΩ	39 Ω to 221 kΩ	39 Ω to 511 kΩ	39 Ω to 1 MΩ
	± 0.1 %	**100 Ω to 130 kΩ**	**47 Ω to 221 kΩ**	**47 Ω to 511 kΩ**	**47 Ω to 1 MΩ**

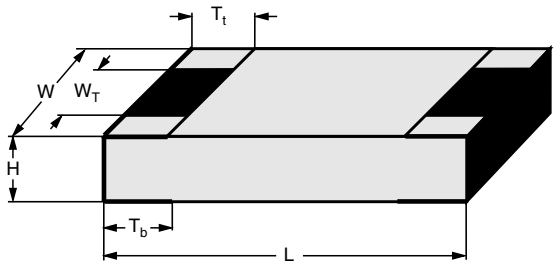
Notes

- Resistance values are available from the E96 and E192 series, other values are available on request.
- **Resistance ranges printed in bold are preferred TCR/tolerance combinations with optimized availability.**

PACKAGING

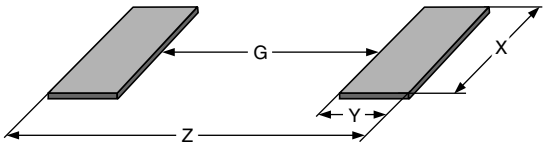
TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
MCS 0402	E1	1000	Paper tape acc. IEC 60286-3 type I	8 mm	2 mm	180 mm/7"
	E0	10 000				
MCT 0603	P1	1000			4 mm	180 mm/7"
	P5	5000				
	PW	20 000				330 mm/13"
MCU 0805	P1	1000				180 mm/7"
	P5	5000				
	PW	20 000				330 mm/13"
MCA 1206	P1	1000				180 mm/7"
	P5	5000				

DIMENSIONS



DIMENSIONS AND MASS							
TYPE	H (mm)	L (mm)	W (mm)	W_T (mm)	T_t (mm)	T_b (mm)	MASS (mg)
MCS 0402	0.32 ± 0.05	1.0 ± 0.05	0.5 ± 0.05	> 75 % of W	0.2 + 0.1/- 0.15	0.2 ± 0.1	0.6
MCT 0603	0.45 + 0.1/- 0.05	1.55 ± 0.05	0.85 ± 0.1	> 75 % of W	0.3 + 0.15/- 0.2	0.3 + 0.15/- 0.2	1.9
MCU 0805	0.45 + 0.1/- 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 + 0.1/- 0.2	0.4 + 0.1/- 0.2	4.6
MCA 1206	0.55 ± 0.1	3.2 + 0.1/- 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

SOLDER PAD DIMENSIONS



RECOMMENDED SOLDER PAD DIMENSIONS								
TYPE	WAVE SOLDERING				REFLOW SOLDERING			
	G (mm)	Y (mm)	X (mm)	Z (mm)	G (mm)	Y (mm)	X (mm)	Z (mm)
MCS 0402	-	-	-	-	0.35	0.55	0.55	1.45
MCT 0603	0.55	1.10	1.10	2.75	0.65	0.70	0.95	2.05
MCU 0805	0.80	1.25	1.50	3.30	0.90	0.90	1.40	2.70
MCA 1206	1.40	1.50	1.90	4.40	1.50	1.15	1.75	3.80

Note

- The given solder pad dimensions reflect the considerations for board design and assembly as outlined e.g. in standards IEC 61188-5-x, or in publication IPC-7351. They do not guarantee any supposed thermal properties, particularly as these are also strongly influenced by many other parameters.

  Still, the given solder pad dimensions will be found adequate for most general applications, e.g. those referring to “standard operation mode”.

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal alloy is deposited on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the desired temperature coefficient. Specially designed inner contacts are deposited on both sides. A special laser is used to achieve the target value by smoothly fine trimming the resistive layer without damaging the ceramics. A further conditioning is applied in order to stabilize the trimming result. The resistor elements are covered by a blue protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure tin on nickel plating.

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual chip resistors. This includes full screening for the elimination of products with potential risk of early field failures (feasible for $R \geq 10\ \Omega$). Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3** [3].

ASSEMBLY

The resistors are suitable for processing on automatic SMD assembly systems and for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system.

The resistors are RoHS compliant, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. Solderability is specified for 2 years after production or requalification. The permitted storage time is 20 years. The immunity of the plating against tin whisker growth has been proven under extensive testing.

All products comply with the **GADSL** [1] and the **CEFIC-EECA-EICTA** [2] list of legal restrictions on hazardous substances. This includes full compliance with the following directives:

- 2000/53/EC End of Vehicle life Directive (ELV) an Annex II (ELV II)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The resistors are approved within the IECQ-CECC Quality Assessment System for Electronic Components to the detail specification **EN 140401-801** which refers to **EN 60115-1**, **EN 140400** and the variety of environmental test procedures of the **IEC 60068** [3] series.

Conformity is attested by the use of the **CECC** logo ( ) as the mark of conformity on the package label.

Vishay Beyschlag has achieved **"Approval of Manufacturer"** in accordance with **IECQ 03-1**. The release certificate for **"Technology Approval Schedule"** in accordance with **CECC 240001** based on **IECQ 03-3** is granted for the Vishay Beyschlag manufacturing process.

RELATED PRODUCTS

Resistors are available with **established reliability** in accordance with **EN 140401-801** version E. Please refer to the special datasheet (www.vishay.com/doc?28744) for information on failure rate level, available resistance ranges and order codes.

For more information about products with higher rated power and higher operation temperature please refer to the **Professional Thin Film Chip Resistor** datasheet (www.vishay.com/doc?28705).

Precision **chip resistor arrays** may be used in voltage divider applications or precision amplifiers where close matching between multiple resistors is necessary. Please refer to the ACAS 0612 - Precision datasheet (www.vishay.com/doc?28751).

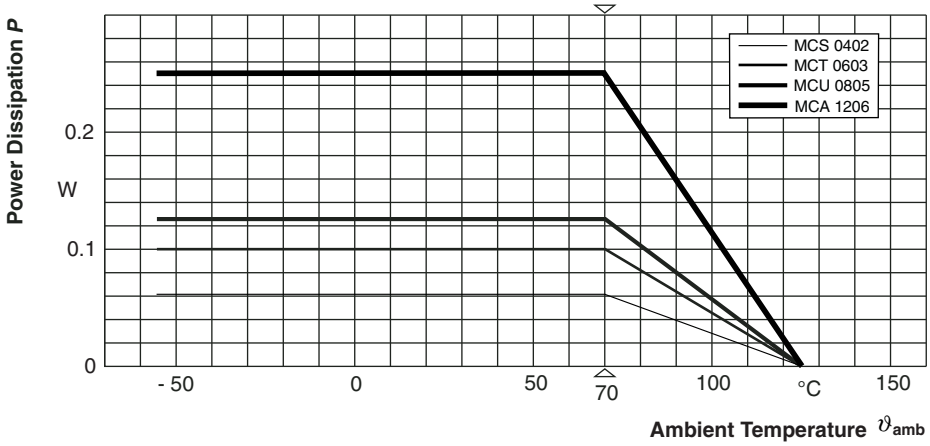
Notes

(1) Global Automotive Declarable Substance List, see www.gadsl.org.

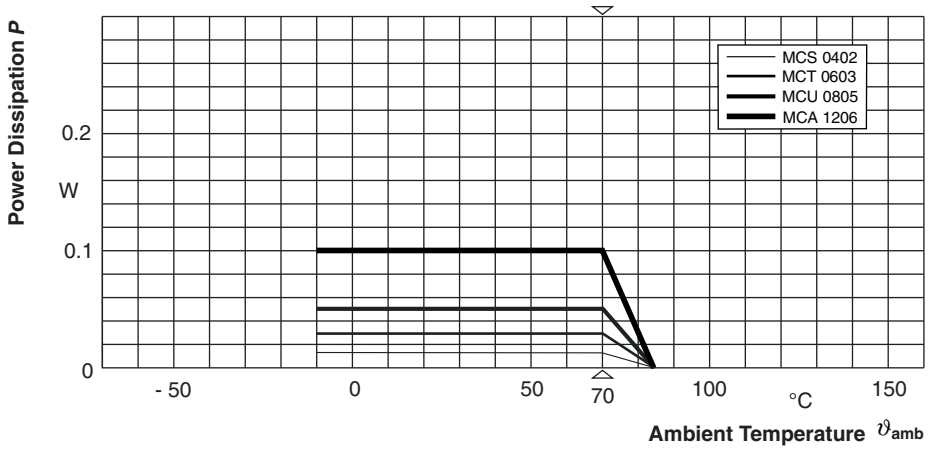
(2) CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organisation representing the information and communications technology and consumer electronics), see www.eicta.org/index.php?id=995 → issues → environment policy → chemicals → chemicals for electronics.

(3) The quoted IEC standards are also released as EN standards with the same number and identical contents.

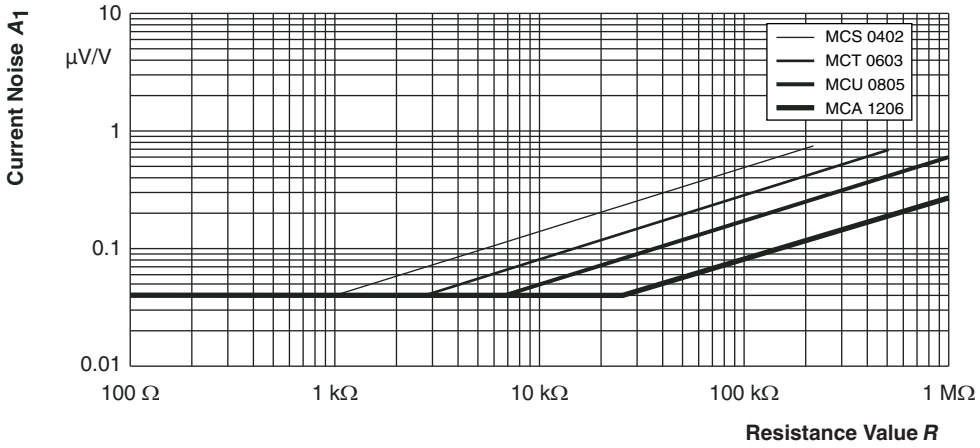
FUNCTIONAL PERFORMANCE



Derating - Standard Operation



Derating - Precision Operation



Current Noise A_1

In accordance with IEC 60195

TESTS AND REQUIREMENTS

All tests are carried out in accordance with the following specifications:

EN 60115-1, generic specification (includes tests)

EN 140400, sectional specification (includes schedule for qualification approval)

EN 140401-801, detail specification (includes schedule for conformance inspection)

The components are approved in accordance with the European CECC-system, where applicable. The following table contains only the most important tests. For the full test schedule refer to the documents listed above. The testing also covers most of the requirements specified by EIA/IS-703 and JIS-C-5202.

The tests are carried out in accordance with IEC 60068 and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3. Climatic category LCT/UCT/56 (rated temperature range: Lower Category Temperature, Upper Category Temperature; damp heat, long term, 56 days) is valid.

Unless otherwise specified the following values apply:

Temperature: 15 °C to 35 °C

Relative humidity: 45 % to 75 %

Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

The components are mounted for testing on boards in accordance with EN 60115-1, 4.31 unless otherwise specified.

The parameters stated in the Test Procedures and Requirements table are based on the required tests and permitted limits of EN 140401-801. However, some additional tests and a number of improvements against those minimum requirements have been included.

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
				STABILITY CLASS 0.1	STABILITY CLASS 0.25
			Stability for product types:		
			MCS 0402	100 Ω to 10 kΩ	> 10 kΩ to 221 kΩ
			MCT 0603	100 Ω to 10 kΩ	39 Ω to < 100 Ω; > 10 kΩ to 511 kΩ
			MCU 0805	100 Ω to 47.5 kΩ	39 Ω to < 100 Ω; > 47.5 kΩ to 1.5 MΩ
			MCA 1206	47 Ω to 332 kΩ	39 Ω to < 47 Ω; > 332 kΩ to 2 MΩ
4.5	-	Resistance	-	± 0.1 % R; ± 0.25 % R	
4.8.4.2	-	Temperature coefficient	At (20/- 10/20) °C and (20/85/20) °C	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K	-
			At (20/- 55/20) °C and (20/125/20) °C	-	± 25 ppm/K; ± 15 ppm/K; ± 10 ppm/K
4.25.1	-	Endurance at 70 °C: Precision operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h	± (0.1 % R + 0.02 Ω) (1)	
			70 °C; 8000 h	± (0.2 % R + 0.02 Ω) (1)	
		Endurance at 70 °C: Standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off; 70 °C; 1000 h	± (0.2 % R + 0.02 Ω) (1)	
			70 °C; 8000 h	± (0.4 % R + 0.05 Ω) (1)	

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
				STABILITY CLASS 0.1	STABILITY CLASS 0.25
			Stability for product types:		
			MCS 0402	100 Ω to 10 kΩ	> 10 kΩ to 221 kΩ
			MCT 0603	100 Ω to 10 kΩ	39 Ω to < 100 Ω; > 10 kΩ to 511 kΩ
			MCU 0805	100 Ω to 47.5 kΩ	39 Ω to < 100 Ω; > 47.5 kΩ to 1.5 MΩ
			MCA 1206	47 Ω to 332 kΩ	39 Ω to < 47 Ω; > 332 kΩ to 2 MΩ
4.25.3	-	Endurance at upper category temperature	85 °C; 1000 h	± (0.1 % R + 0.02 Ω)	± (0.2 % R + 0.02 Ω)
			125 °C; 1000 h	± (0.2 % R + 0.02 Ω)	± (0.25 % R + 0.05 Ω)
4.24	78 (Cab)	Damp heat, steady state	(40 ± 2) °C; 56 days; (93 ± 3) % RH	± (0.1 % R + 0.02 Ω)	± (0.25 % R + 0.05 Ω)
4.23		Climatic sequence: Standard operation mode:		± (0.1 % R + 0.02 Ω)	± (0.25 % R + 0.05 Ω)
4.23.2	2 (Ba)	Dry heat	125 °C; 16 h		
4.23.3	30 (Db)	Damp heat, cyclic	55 °C; 24 h; > 90 % RH; 1 cycle		
4.23.4	1 (Aa)	Cold	- 55 °C; 2 h		
4.23.5	13 (M)	Low air pressure	8.5 kPa; 2 h; (25 ± 10) °C		
4.23.6	30 (Db)	Damp heat, cyclic	55 °C; 24 h; > 90 % RH; 5 cycles		
4.23.7	-	DC load	$U = \sqrt{P_{70} \times R} \leq U_{max.}$; 1 min.		
-	1 (Aa)	Cold	- 55 °C; 2 h	± (0.05 % R + 0.01 Ω)	
4.19	14 (Na)	Rapid change of temperature	30 min at LCT and 30 min at UCT; LCT = - 10 °C; UCT = 85 °C; 5 cycles	± (0.05 % R + 0.01 Ω) no visible damage	
			LCT = - 55 °C; UCT = 125 °C; 1000 cycles	± (0.25 % R + 0.05 Ω) no visible damage	
4.13	-	Short time overload: Precision operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s	± (0.05 % R + 0.01 Ω)	
		Short time overload: Standard operation mode	$U = 2.5 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 5 s	± (0.05 % R + 0.01 Ω)	
4.27	-	Single pulse high voltage overload: Standard operation mode	Severity no. 4: $U = 10 \times \sqrt{P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 10 pulses 10 µs/700 µs	± (0.5 % R + 0.05 Ω) (2) no visible damage	

TEST PROCEDURES AND REQUIREMENTS

EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
				STABILITY CLASS 0.1	STABILITY CLASS 0.25
			Stability for product types:		
			MCS 0402	100 Ω to 10 kΩ	> 10 kΩ to 221 kΩ
			MCT 0603	100 Ω to 10 kΩ	39 Ω to < 100 Ω; > 10 kΩ to 511 kΩ
			MCU 0805	100 Ω to 47.5 kΩ	39 Ω to < 100 Ω; > 47.5 kΩ to 1.5 MΩ
			MCA 1206	47 Ω to 332 kΩ	39 Ω to < 47 Ω; > 332 kΩ to 2 MΩ
4.37	-	Periodic electric overload: Standard operation mode	$U = \sqrt{15 \times P_{70} \times R}$ or $U = 2 \times U_{max.}$; whichever is the less severe; 0.1 s on; 2.5 s off; 1000 cycles	± (0.5 % R + 0.05 Ω) (2) no visible damage	
4.40	-	Electro static discharge (Human Body Model)	IEC 61340-3-1; 3 pos. + 3 neg. (equivalent to MIL-STD-883, method 3015) MCS 0402: 500 V MCT 0603: 1000 V MCU 0805: 1500 V MCA 1206: 2000 V	± (0.5 % R + 0.05 Ω)	
4.22	6 (Fc)	Vibration	Endurance by sweeping; 10 Hz to 2000 Hz; no resonance; amplitude ≤ 1.5 mm or ≤ 200 m/s^2; 7.5 h	± (0.05 % R + 0.01 Ω) no visible damage	
4.17.2	58 (Td)	Solderability	Solder bath method; SnPb40; non-activated flux; (215 ± 3) °C; (3 ± 0.3) s	Good tinning (≥ 95 % covered); no visible damage	
			Solder bath method; SnAg3Cu0.5 or SnAg3.5; non-activated flux; (235 ± 3) °C; (2 ± 0.2) s	Good tinning (≥ 95 % covered); no visible damage	
4.18.2	58 (Td)	Resistance to soldering heat	Solder bath method; (260 ± 5) °C; (10 ± 1) s	± (0.05 % R + 0.01 Ω)	
4.29	45 (XA)	Component solvent resistance	Isopropyl alcohol; + 50 °C; method 2	No visible damage	
4.32	21 (Ue_3)	Shear (adhesion)	RR1005M and RR1608M; 9 N	No visible damage	
			RR2012M and RR3216M; 45 N	No visible damage	
4.33	21 (Ue_1)	Substrate bending	Depth 2 mm, 3 times	± (0.05 % R + 0.01 Ω) no visible damage, no open circuit in bent position	
4.7	-	Voltage proof	$U_{RMS} = U_{ins}$; (60 ± 5) s	No flashover or breakdown	
4.35	-	Flammability	IEC 60695-2-2, needle flame test; 10 s	No burning after 30 s	

TEST PROCEDURES AND REQUIREMENTS					
EN 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE (ΔR)	
				STABILITY CLASS 0.1	STABILITY CLASS 0.25
			Stability for product types:		
			MCS 0402	100 Ω to 10 kΩ	> 10 kΩ to 221 kΩ
			MCT 0603	100 Ω to 10 kΩ	39 Ω to < 100 Ω; > 10 kΩ to 511 kΩ
			MCU 0805	100 Ω to 47.5 kΩ	39 Ω to < 100 Ω; > 47.5 kΩ to 1.5 MΩ
			MCA 1206	47 Ω to 332 kΩ	39 Ω to < 47 Ω; > 332 kΩ to 2 MΩ
Special requirements for type MCA 1206					
4.25.1	-	Endurance at 70 °C: Precision operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off;		
			70 °C; 1000 h	± (0.05 % R + 0.02 Ω)	
			70 °C; 8000 h	± (0.1 % R + 0.02 Ω)	
		Endurance at 70 °C: Standard operation mode	$U = \sqrt{P_{70} \times R}$ or $U = U_{max.}$; whichever is the less severe; 1.5 h on; 0.5 h off;		
			70 °C; 1000 h	± (0.1 % R + 0.02 Ω)	
			70 °C; 8000 h	± (0.25 % R + 0.05 Ω)	

Notes

(1) See 4.25.1 (above): special requirements for type MCA 1206.

(2) The pulse load stability of professional MFC resistors applies for precision resistors also. However, severe pulse loads are likely to jeopardise precision stability requirements.

HISTORICAL 12NC INFORMATION

- The resistors had a 12-digit numeric code starting with 2312.
- The subsequent 4 digits indicated the resistor type, specification and packaging; see the 12NC table.
- The remaining 4 digits indicated the resistance value:
  - The first 3 digits indicated the resistance value.
  - The last digit indicated the resistance decade in accordance with the 12NC Indicating Resistance Decade table.

Last Digit of 12NC Indicating Resistance Decade

RESISTANCE DECADE	LAST DIGIT
10 Ω to 99.9 Ω	9
100 Ω to 999 Ω	1
1 kΩ to 9.99 kΩ	2
10 kΩ to 99.9 kΩ	3
100 kΩ to 999 kΩ	4
1 MΩ to 9.99 MΩ	5

Historical 12NC example

The 12NC of a MCT 0603 resistor, value 47 kΩ and TCR 25 with ± 0.1 % tolerance, supplied in cardboard tape of 5000 units per reel was: 2312 216 74703.

HISTORICAL 12NC - Resistors type and packaging

DESCRIPTION			2312...				
			CARDBOARD TAPE ON REEL				
TYPE	TCR	TOL.	P1 1000 UNITS	P5 5000 UNITS	PW 20 000 UNITS	E1 1000 UNITS	E0 10 000 UNITS
MCS 0402	± 25 ppm/K	± 0.25 %	-	-	-	261 6....	276 6....
		± 0.1 %	-	-	-	261 7....	276 7....
	± 15 ppm/K	± 0.25 %	-	-	-	262 6....	277 6....
		± 0.1 %	-	-	-	262 7....	277 7....
	± 10 ppm/K	± 0.25 %	-	-	-	263 6....	278 6....
		± 0.1 %	-	-	-	263 7....	278 7....
MCT 0603	± 25 ppm/K	± 0.25 %	201 6....	216 6....	206 6....	-	-
		± 0.1 %	201 7....	216 7....	206 7....	-	-
	± 15 ppm/K	± 0.25 %	202 6....	217 6....	207 6....	-	-
		± 0.1 %	202 7....	217 7....	207 7....	-	-
	± 10 ppm/K	± 0.25 %	203 6....	218 6....	208 6....	-	-
		± 0.1 %	203 7....	218 7....	208 7....	-	-
MCU 0805	± 25 ppm/K	± 0.25 %	241 6....	256 6....	246 6....	-	-
		± 0.1 %	241 7....	256 7....	246 7....	-	-
	± 15 ppm/K	± 0.25 %	242 6....	257 6....	247 6....	-	-
		± 0.1 %	242 7....	257 7....	247 7....	-	-
	± 10 ppm/K	± 0.25 %	243 6....	258 6....	248 6....	-	-
		± 0.1 %	243 7....	258 7....	248 7....	-	-
MCA 1206	± 25 ppm/K	± 0.25 %	381 6....	396 6....	386 6....	-	-
		± 0.1 %	381 7....	396 7....	386 7....	-	-
	± 15 ppm/K	± 0.25 %	382 6....	397 6....	387 6....	-	-
		± 0.1 %	382 7....	397 7....	387 7....	-	-
	± 10 ppm/K	± 0.25 %	383 6....	398 6....	388 6....	-	-
		± 0.1 %	383 7....	398 7....	388 7....	-	-

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